DØ SMT Status Report

Milestones

- 11/03/99: 2-degree ladder production 20% complete
  - Met on time
- 11/5/99 M3: F Wedge production begun
  - Started at low rate week of 11/8/99
    - » Problems with low yield of hdi hybrids
- 1/19/00: 6-chip ladder fabrication 20% complete
  - Not met
    - » Problems with sensors, need for visual inspection
    - » Inadequate sensor delivery rate from Micron
  - Current ladder rate 1/day. Milestone delayed by 1.5 - 2 weeks
- 1/19/00: Complete first barrel
  - Not met
    - » Uneven production of 2^{o} ladder types needed (oversight)
    - » qualifying of ladders still in progress; panel formed to adjudicate on detectors
  - Milestone delayed by 3-4 weeks
  - A diverse infrastructure has to be in place; competing with cosmic ray stand
  - Does not affect production!

Near Future Milestones

- 01/24/00: F-wedge assemblies 20% complete
  - Will not meet
    - » Vendor problems (15 lost hdi's (12 per disk))
    - » Unavailability of CMM machine at Sidet; ladder CMM had to be shared
  - Delayed by 1-2 weeks
- 02/02/00 M2: First Silicon barrel/disk module complete
  - Will be set back as much as first barrel completion
  - Note: no full read out system available to read out full barrel/disk assembly until March

Milestones are being revisited, linked with fallback scenarios

Silicon Sensors

Barrel

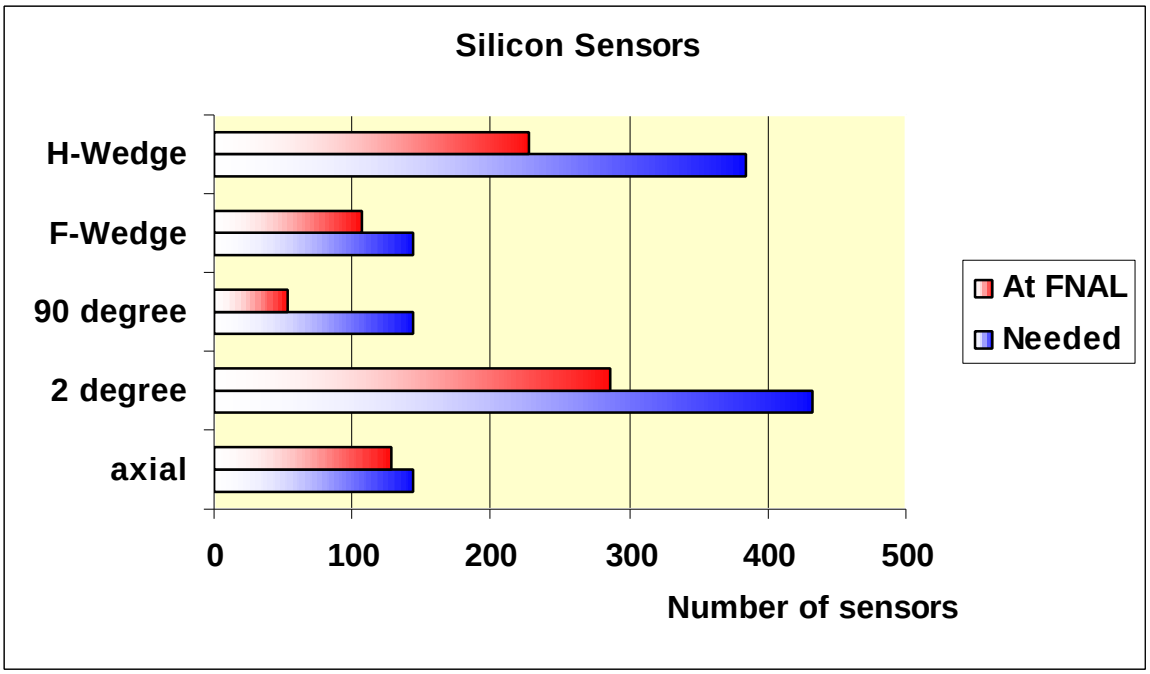
- Axial detectors (3-chip):
  - Need to order 20 more sensors
  - No delivery problems
- 90^{o} detectors (6-chip):
  - First batch of sensors had defects (p-stop touches n+ implant); each device visually scanned
  - currently ~60 sensors in hand (144 needed) but problems with noise (19 ladders built)
  - Micron delivery remains worrisome (~15/Jan)
  - Need ~10 sensors/week to complete detector
  - Huge (~600) number of sensors in production line, but Micron staff is stretched thin.
    - » We appealed for help on Dec 9, 99
    - » Our Czech collaborators offered to station on average 1.5 people at Micron to help with testing devices on site for 6 months
    - » On Jan 10, 00 our Czech collaborator at Micron
  - production will be paced by Micron delivery
  - production schedules may force us to accept lower grade devices

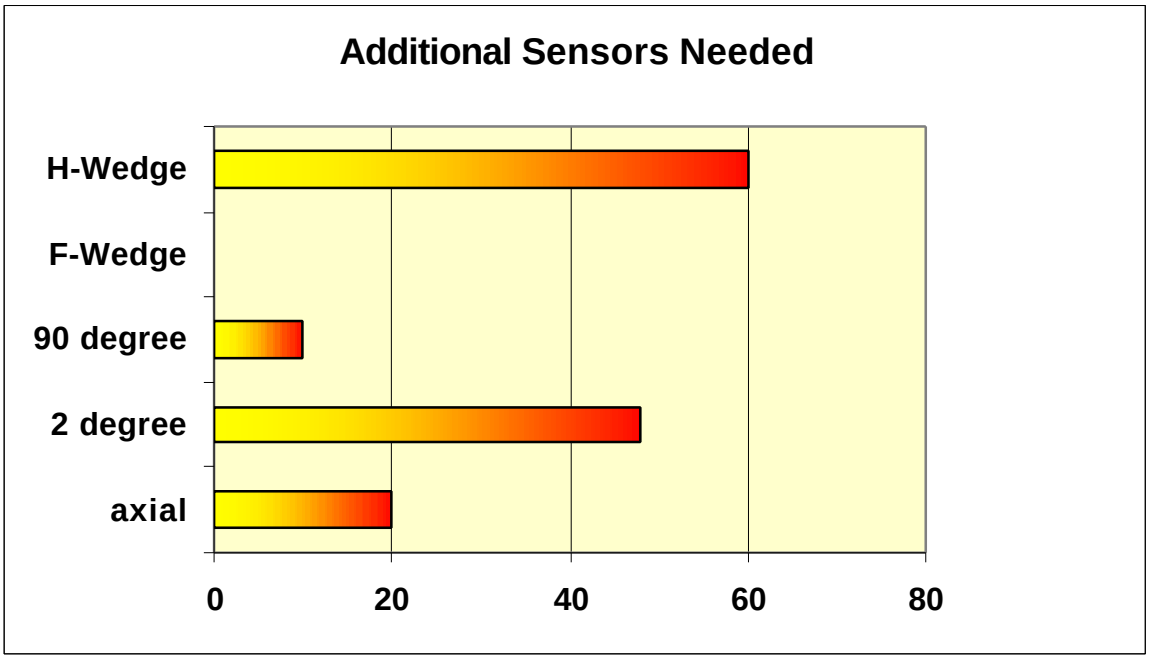
- 2^o detectors (9-chip):
  - sensor production proceeding well; last set of sensors: 19/25 passed.
  - Full delivery of order anticipated in April
  - Need to order 48 additional sensors

Disks

- F Wedges:
  - Proceeding okay at yield of 50-60% at Micron
  - Currently 43 wafers in production, 25 needed; last batch: 5/6 passed
  - Completion of order for 125 detectors expected by March
  - First of order for 75 sensors from Eurisys received (5)
    - » larger bias resistance than specified (add SiO_2 layer)
    - » lower breakdown voltage (60-80V) (change p-implant concentration)
  - Timely delivery is anticipated
- H Wedges:
  - due to larger than expected use of devices for prototyping 60 additional sensors need to be reordered to complete full H disk

Summary of Sensor Status

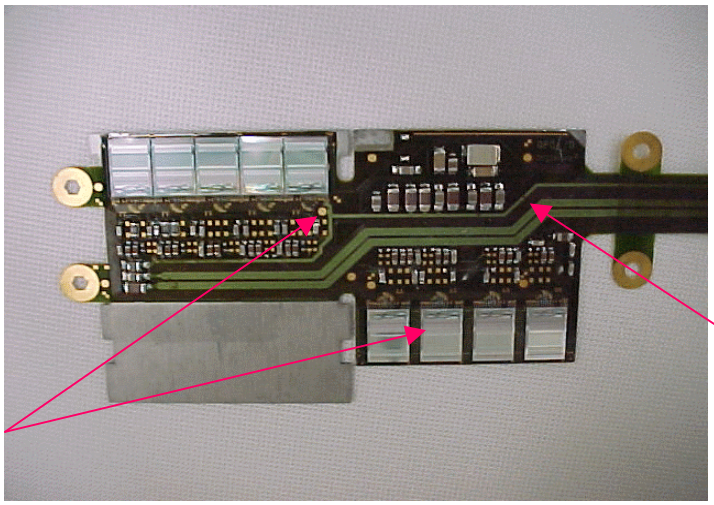




- All sensors are in production line. No delay in module production anticipated due to purchase of additional sensors, except for 90° sensors.

High Density Interconnect (HDI)

- Flexible Kapton/Cu circuit which provides the read out of the silicon
- Surface mount and chip bonding done at Promex (CA)
- Multitude of problems
  - weak wirebonds, pull strength 2 grams (7 nominal)
  - wirebonds don't stick; hdi's rejected by company
  - poor quality of work performed
    - » poor wirebonds
    - » no dye attach
    - » chips don't download
    - » shipping disasters
    - » ……
  - Recently lost 14 F wedge hdi's
- F Wedge hdi especially intricate device
  - 2 hdi's glued back to back
  - additional jumper (pitch adapter) for 6 chip side (n-side) from different vendor (Max Levy)
- Qualifying alternate vendor, Silitronics

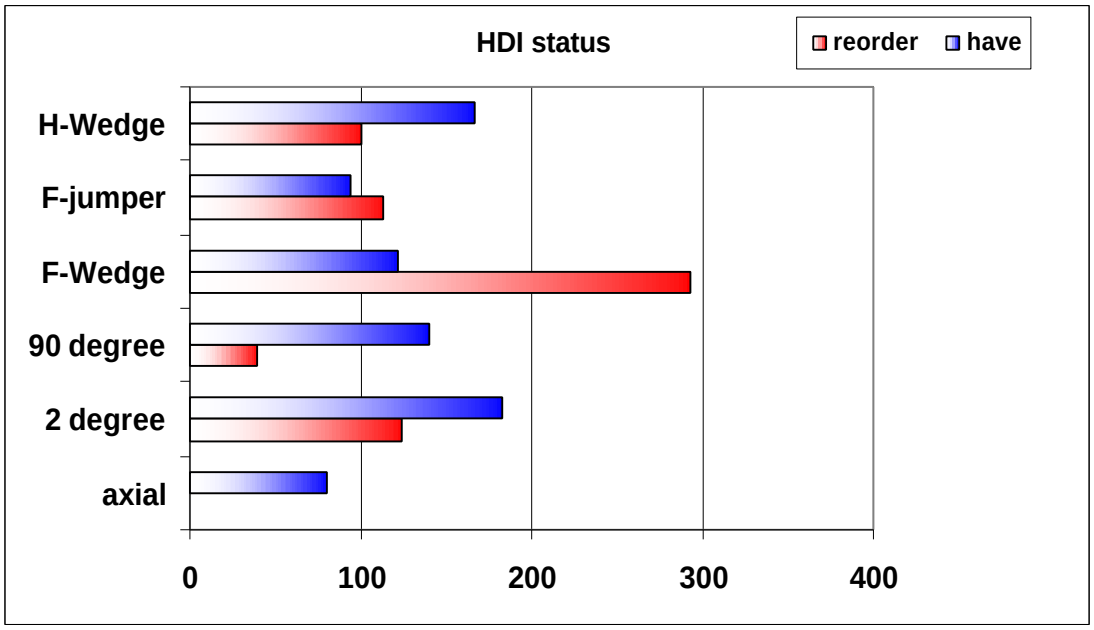


HDI Status

- The Si group tries to provide oversight at the companies while hdi's are being stuffed
- Contacted SLAC (Guenther Haller) for help, but ...
- overall yield fluctuates: 60-90%

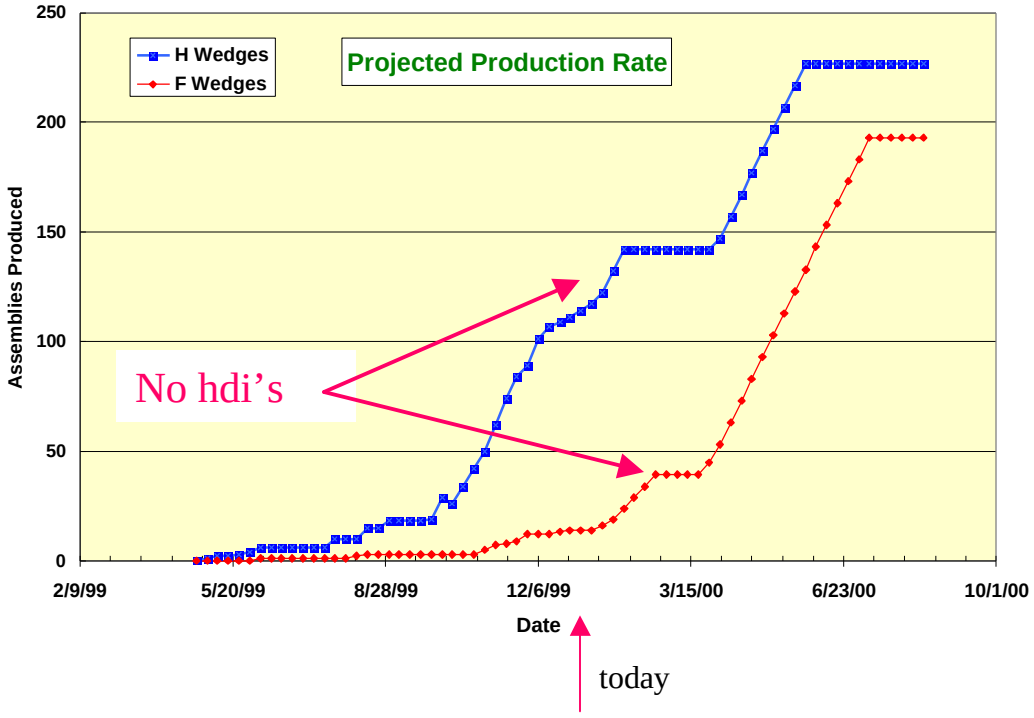
	hdi probing	lamination	stuffing	overall
9-chip	0.95	0.97	0.80	0.74
6-chip	0.93	0.95	0.85	0.75
F-disk	1.00	0.90	0.80	0.72
H-disk	0.90	1.00	0.78	0.70

- Because of the low yields, additional hdi's will have to be reordered to complete the detector



Implications of additional hdi purchase

- Significant strain on budget
- Significant impact on production schedule
  - F wedge production
    - » F wedge production projected to be halted for one month in March due to non availability of F wedge hdi's
  - H Wedge production
    - » H wedge production projected to be halted for one month in February due to non availability of H wedge hdi's (but not a problem since effort is diverted into building of full wedges)

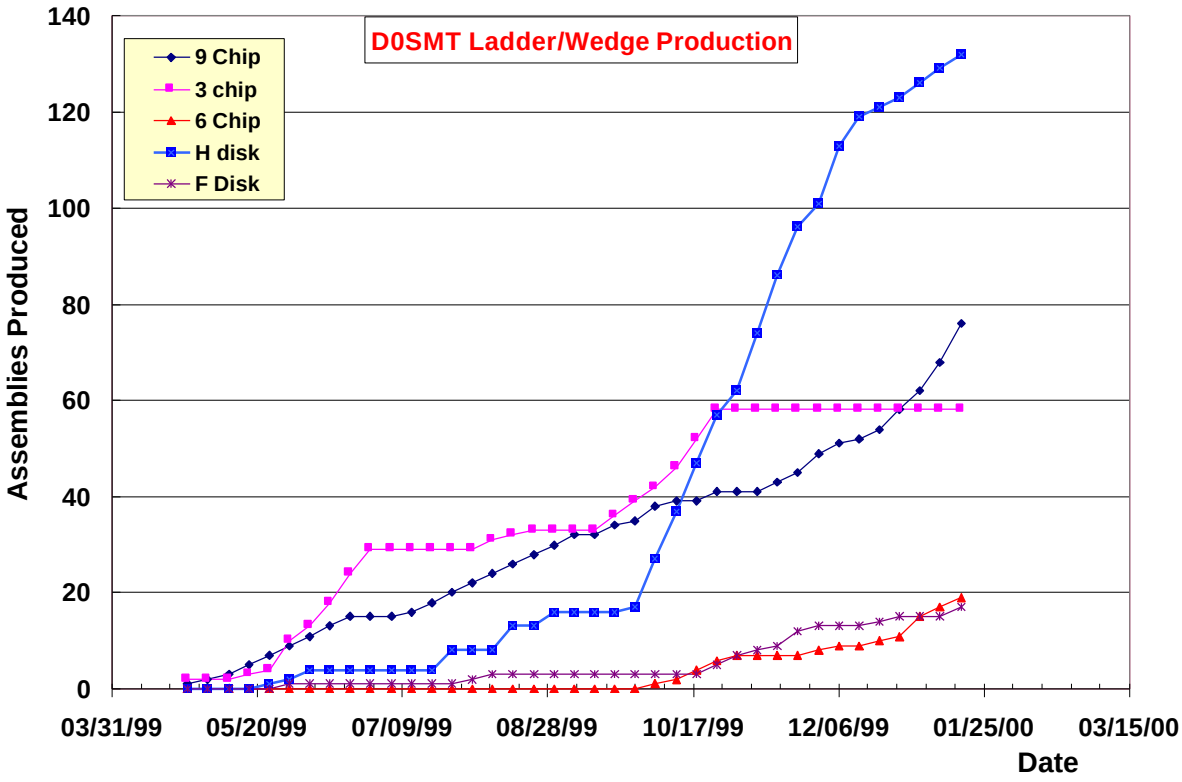


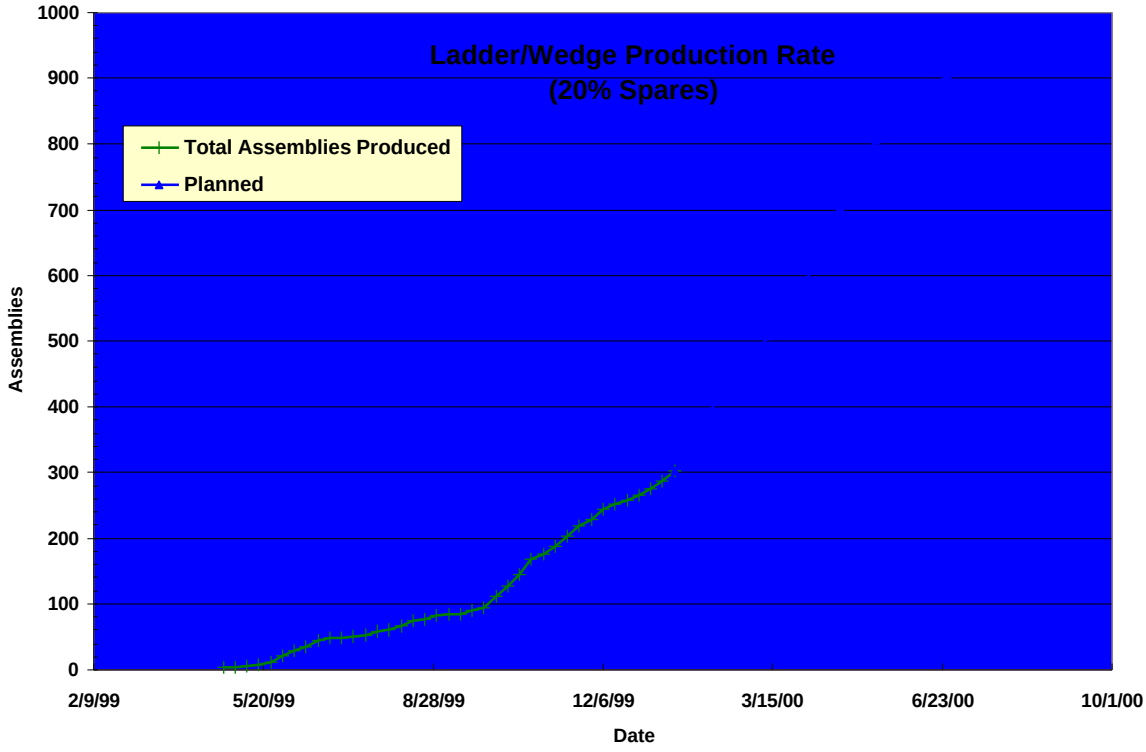
- Promex now claiming it needs 4 weeks lead time
- Impression that lost hdi's were due to pressure from us

Ladder and Wedge Production

- Axial detectors (3-chip):
  - 58 ladders built to date, 72 needed
  - Production halted:
    - » effort diverted to 2º detectors
    - » no hdi's available
  - Can complete full complement of detectors in 3 weeks
- 2º detectors (9-chip):
  - Production lagged due to qualifying of fixtures
  - Fourth and last fixture should be qualified this week
  - Eliminated one glue cycle from production
  - Currently building 2 ladders/day which can go up to 4 ladders/day, 20/week
- 90º detectors (6-chip):
  - One fixture qualified with production of 1 ladder/day
  - Second fixture being qualified and two additional on order
  - A second production line in Lab A has been set up with one CMM, to be extended to two CMM's
  - Production will be limited due to:
    - » Micron sensor delivery, built ladders when sensors sent
    - » Inspecting, probing and testing of sensors
    - » Schedule may impose acceptance of lower grade devices
- F Wedges (14-chip):
  - Limited by availability of hdi's
  - Current rate 1/day, go to 2/day
- H Wedges (6-chip):
  - In steady production, 2/day

Production Status





Notes on Production

- Micron issues addressed
  - » 2 people permanently at Micron for duration
  - » 90 degree sensors remain very critical
- Can increase 9-chip ladder production to 20/week
- Set up second production line in Lab A for 6-chip ladder production. Could go to ~20/week
- Addressed as is reasonably possible stuffing of hdi's
- Added new fast wirebonder (8090)
- Added technicians to production line
- Created Engineering Physicist Opening to help with ladder production and engineering; offer out
- Approval for hiring additional person as visitor
- ….

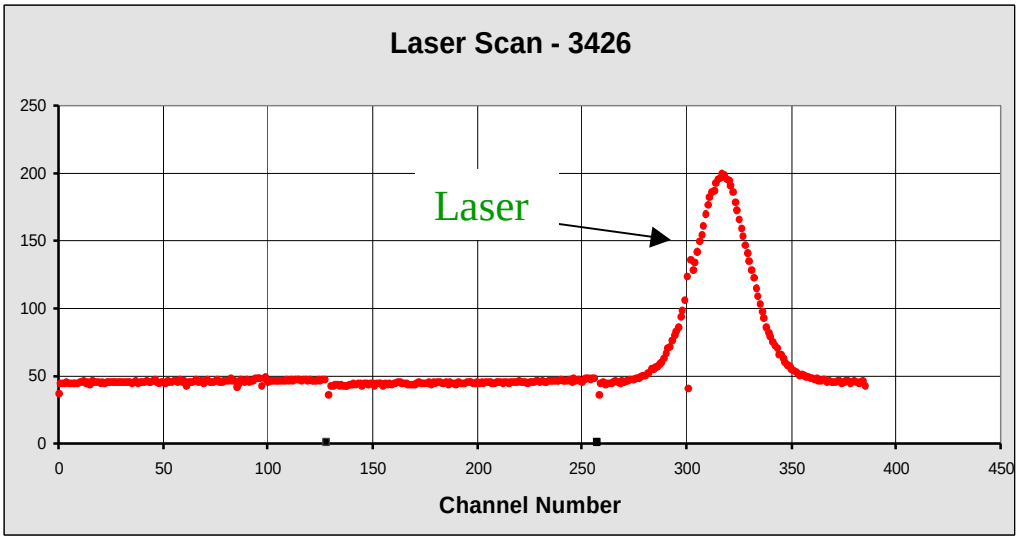
Thank you!

Production schedule is formidable, but achievable

Burn-in, Testing and Repair

- Regular review of testing results among various groups
- Testing and repair is very tedious, iterative process
- Very time consuming; problem devices can easily take >1 day to debug

- All devices have to be tested and debugged
- Currently shortage of manpower, which is being addressed
- Laser test of all devices started again this week with shifters



- Measure depletion voltage
- leakage currents
- dead channels
- …… store information

- Started this week with shifters
- Can be done very effectively

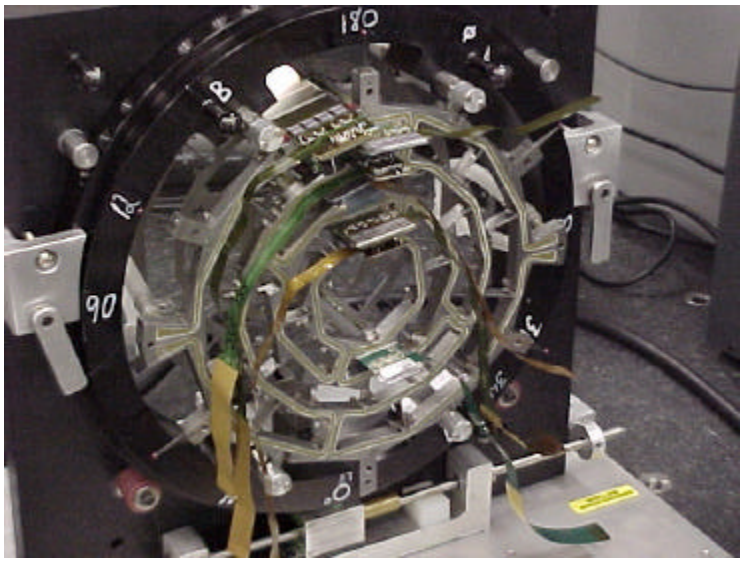
Infrastructure

- Current Test stands: 7
  - two test stands for burn in (PC3, PC6)
  - two test stands for laser test (PC2, PC7)
  - one debug (Lab D), one repair (semi), one multipurpose test stand
- Future Test stands:
  - hdi burn-in test stand added ladder burn-in capability
  - one additional debug test stand (Lab D)
  - one additional small scale full read out system

Silicon facility has to become streamlined production line with adequate manpower in each link of the chain. Testing/repair/debugging currently weakest link in chain, but being addressed. Need influx from collaboration.

Read Out and Assembly

- Currently available 6 low mass cables and able to read out
- Will move to 6+6 ladder setup in spare Be support structure and exercise full read out system, DAQ, L3 and on/offline software, controls and monitoring shortly
- First pass at cosmics end of January



Array of 4 scintillator counters form external trigger

Momentum analyzing steel, $p_T^{\mu} > 2$ GeV/c

Data Rate ~ 1 cosmic/min

- Ladder Installation being exercised
- Full H Wedge construction and H wedge mounting exercised